

Arsenic in the Arts as a Cause of Arsenical Poisoning.

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MR. PRESIDENT AND GENTLEMEN: Every science has its border lands, which are also the border lands of other contiguous sciences. In many cases the precise boundary lines are ill-defined—possibly indefinable. Occasionally, in the progress of knowledge and civilization, some parts of these neutral territories are themselves organized into independent provinces. For example, between the sciences of Law and Medicine lies the large territory of Medical Jurisprudence, belonging strictly to neither, yet intimately concerning both. This fact was early recognized. The Roman law referred all medical questions which arose in the course of legal proceedings to "the authority of the learned Hippocrates." The publication of the *Questiones Medico-Legales* by Paulus Bacchias, between 1621 and 1650, was the full inauguration of this new and still enlarging domain of scientific knowledge. Just two centuries later, an important part of this great field was recognized as the distinct department of *Chemical Jurisprudence or Toxicology*, when Orfila, in 1813-15, published the first edition of his *Traité des Poisons, ou Toxicologie Generale*. Within the last half century toxicology, responding to the severe demands of the various tribunals of justice, has laid all kindred sciences under tribute, pressing into its service all their most refined methods of research, until it now, with the keen tests of chemistry, the microscope and the spectroscopic, pursues the criminal as a fleet and unerring Nemesis.

The department of chemical technology has furnished to the medical practitioner important aid in unfolding to him causes affecting life and health among the noxious materials and processes employed in the industrial arts.

Moreover, it is precisely along these lines of unoccupied territory that just now the medical profession chiefly,—nay, almost exclusively, by its own uncompensated efforts, is raising the new domain of Preventive Medicine or Sanitary Science to a position of commanding eminence. Its comprehensive beneficence embraces the humblest and the lowliest. It not only proposes to show every man that he is, in a new sense, his brother's keeper, but it also proposes to compel him, if necessary, to do that duty.

It is only on this border land between the science of medicine, represented here to-day by so many learned and distinguished men, and the science of chemistry that I could venture to meet you in response to the courteous invitation of your President.

The earliest investigations concerning the chemical properties of arsenic date from the former part of the last century. Previous to this time, it is true, some of its compounds had been known as a fearful poison sometimes employed for criminal purposes. In matters of state and of love its potent aid was not infrequently invoked. Estates and even thrones occasionally became suddenly and conveniently vacant for some expectant and unscrupulous heir. In Southern Europe, during the sixteenth and seventeenth centuries, secret poisoning became so common that the popular alarm arose almost to a panic. The famous *Aqua Tofana*, doubtless a compound of arsenic, since it was a limpid and tasteless fluid, became a fearful instrument of destruction in the hands of the celebrated demon, Tofana of Palermo, from whom it derived its name, and who, when put to the rack, confessed to having poisoned no less than six hundred persons.

After the execution of Tofana it is said an organized society was discovered in Rome whose object was the removal by poison of persons obnoxious to its members. The fortune teller often added to her profession that of secret poisoner. She might confidently predict the early death of a person who stood in the way of her client, since the means of insuring the fulfillment of her prophecy were in her own hands. It was believed that the art of poisoning had reached such a degree of refinement that the death of the victim might be fixed at any future period by simply adjusting the potency of the poison. The history of Madame Brinvilliers of Paris, who was executed just two hundred years ago, is well known. She prepared herself for her future profession in a thoroughly scientific manner by studying the effects of *Aqua Tofana* and of *poudre de succession* upon the unsuspecting patients in the Paris hospital. She then proceeded, *secundum artem*, to destroy her father, brothers, and many others.

Happily for society, Toxicological science, by bringing to the light such secret practices, has made the existence of such monsters no longer possible.

In modern times, arsenic has passed from the hands of the assassin and become an article of widely extended use in the arts, especially those that minister to our taste for the beautiful. The quantity consumed annually is enormous and is constantly increasing. New uses for it arise almost daily. It finds its way into every household. In view of its deleterious and often fatal effects, even in minute quantities, the freedom—rather the recklessness, with which it is placed in the hands of unsuspecting persons is highly reprehensible and should, by some efficient means, be checked.

Arsenic is not an abundant element in nature, but is most widely diffused. It is especially associated with many metallic ores. It occurs in small quantity in many mineral waters, especially alkaline and ferruginous waters, such as those in the valley of Vichy, Plombières, Karlsbad and Kissingen, and to its presence has been attributed the therapeutic value of these waters. It is of common occurrence in iron-

pyrites, from which sulphuric acid is sometimes made; and thus this useful acid is often found arsenical to such a degree as to unfit it for certain uses. Thus, too, it passes into other products into which this acid enters, or in the preparation of which it has been employed. It has been detected even in carbonate of soda, which is obtained from common salt by means of sulphuric acid.

ARSENICAL COLORS.

Until recently the chief use of arsenic has been for the manufacture of colors. Combined with sulphur, it yields two sulphides—yellow arsenic or orpiment, and red arsenic or realgar. The splendid emerald green color produced by combining arsenic with copper, or the acetate of copper, on account of its unparalleled brilliancy, and its permanency, has won its way to popular favor, despite its poisonous character. The arsenite of copper, or Scheele's green, contains 55 per cent. of white arsenic, and the aceto-arsenite, or Schweinfurt green, 58 per cent. The latter color is also known in commerce by a bewildering number of aliases, such as imperial green, emerald green, mineral green, Brunswick green, Vienna green, Vert de Montagne, &c. A painter recently told me that he did not use emerald green because it was poison, but he used in its place Vert de Montagne. He was deceived by a name.

On account of the insolubility of these arsenical pigments in any fluid which does not decompose them, they cannot be employed as dyes. Their use is therefore limited to cases where they can either be fixed upon the fabric or incorporated into its substance during the process of manufacture. They are also used both as oil and water colors.

A cake of Windsor and Newton's emerald green water color, which I recently had occasion to analyze, contained nearly 40 per cent. of arsenic—enough to kill ten people.

In the dress goods known as green tartan the color is emerald green, simply fixed upon the fabric with starch or size. Bright green artificial flowers are colored in the same manner. In decorative and wall papers, and card board, the color is spread on one side of the paper, the surface being left dull or glazed as may be desired.

In writing paper the color is mixed with the pulp and thus is incorporated into the texture. In such paper the vivid green is usually toned down by some white powder to a pale sea-green.

The State Boards of Health, of Massachusetts, and of Michigan, have, in their reports, called the special attention of the public to the great danger of poisoning from arsenical wall papers. In the latter State, samples of poisonous paper have been collected, bound into a volume, one hundred copies of which have been distributed to the principal libraries of the State, for the purpose of educating the public in some measure to protect themselves from this insidious danger.

ANILINE COLORS.

The aniline colors are obtained indirectly from coal tar, but directly from "aniline oil," by treating it with certain reagents. The majority of manufacturers prefer arsenic, notwithstanding the danger of poisoning to which the workmen are exposed and the difficulty of disposing of large volumes of poisonous residues. In some manufactures in Europe one hundred tons of arsenic are thus consumed in a single year. The beautiful color fuchsin, when made according to the French mode, is said always to contain arsenic, and since this color is the basis of nearly all other aniline colors, it is readily seen that at least a large number are liable to be poisonous. Yet we wear it in our apparel, we eat it in sweetmeats, we drink it in syrup, we write with it as ink.

MISCELLANEOUS USES OF ARSENIC.

In calico printing, of late, arsenate of alumina has been extensively substituted for alumina, and arsenic acid for the more costly tartaric acid. A crude arsenical ore, or "black arsenic," is often sold as "fly-powder" or even "cobalt," and used in the household for destroying flies. Lead shot contains arsenic, which is added to improve the spherical shape. In pyrotechny red arsenic is used in Indian fire or Bengal white fire. The transparency of glass is improved by adding a little arsenic. An arsenical soap is used by taxidermists to preserve the skins of stuffed animals. Hence you often leave a museum with a head-ache—slightly poisoned. A mixture of lime and yellow arsenic is used in dressing skins to remove the hair or wool. Shepherds use an arsenical mixture some times for "dipping" sheep. Yellow arsenic is used in India in preparing shellac for the market. Both the yellow and green pigments are used—less commonly than formerly—in coloring children's toys and candies. In solutions for bronzing, workmen often employ arsenic from which they suffer greatly. Candies are often colored green or yellow by arsenical pigments, and sometimes the wicks are saturated with arsenic to improve the brilliancy of the light.

ARSENIC IN AGRICULTURE—PARIS GREEN.

In the late war with insect invaders, farmers have sought in a variety of poisons a means of protection. White arsenic has been used to a limited extent, but a wholesome fear of its deadly character has checked its popularity. The most successful competitor for popular favor has been Paris green which is only another alias for the aceto-arsenite of copper, or the emerald green of the painter. If pure, Paris green should contain 58 per cent. of its weight of white arsenic, but it is usually liberally diluted with sulphate of baryta. The samples which I have had occasion to analyze have contained from 11 to 27 per cent. of this heavy, harmless make-weight. The quantity of this poisonous powder used in the Western States is enormous. More than a ton has been sold in a single small village in a year. Numerous instances of more or less serious poisoning by Paris green, from inhalation of the dust and from cutaneous absorption, especially where there has been abrasion of the skin, have been reported.

The familiarity of the public with the highly poisonous effects of arsenic, the facility with which it can be obtained, the ease with which it can be administered on account of its freedom from taste, have conspired to render death from arsenical poisoning more frequent than from any other poison. Consequently Toxicologists have given special attention to its physiological effects and to the methods of recovery, identifying it and bringing it as a substantial witness into court to testify against the guilty. The facility with which it may be separated from all other substances and the possibility of identifying it beyond all doubt, even in microscopic traces, are now well understood.

The compounds of this element are marked

by two singular characteristics. Most arsenical compounds, excepting those of the alkalis, are insoluble and yet they react at once, and powerfully whenever applied to the mucous membranes or introduced into the blood. They rapidly pervade the system, soon appearing in the liver, in the renal excretions, and pervading the nervous matter and even the brain. In other cases, long after the tissues have suffered decomposition, the bones have yielded up their testimony, under the inquisition of chemistry, in the shape of absorbed arsenic.

POISONOUS EFFECTS.

While the investigation of the fatal cases belongs to the Toxicologists, that of the non-fatal cases belongs to the physician. The voluminous literature of toxicology and of sanitary science abounds in clearly marked cases of chronic poisoning from arsenic, when the quantity of substance entering the system must have been infinitesimally small. Can chronic poisoning occur from the occupancy of a room whose walls are covered with arsenical paper? Multitudes of cases could be cited from the most careful and competent observers. Fatal cases even are recorded.

Dr. Taylor, in his "Treatise on Poisons"—an authority of the highest rank—speaks thus on this important subject: "The symptoms produced by arsenicated wall-papers are of a uniform character, showing their origin from a common cause. They are as follows: Dryness and irritation of the throat with cough, irritation of the mucous membrane of the eyes and nostrils, dry cough, shortness of breathing, languor, headache, loss of appetite, nausea, colicky pains, numbness, great prostration of strength, sleeplessness, a feverish condition, and wasting of the body. These symptoms may not all present themselves in any one case; they are derived from the examination of numerous cases which have been referred to me. They resemble those of a severe cold. No suspicion of the real cause has been entertained until after all ordinary treatment had failed to impart relief and an analysis of the paper had been made. The connection of the symptoms with this cause appears to have been in some instances established by the fact that after the removal of the paper, especially from bedrooms, the symptoms have disappeared."

The slight manner in which the arsenical color is laid on wall-paper, as already explained, shows how easily it may be detached and go its way to mingle with the general dust of the room. Indeed the arsenic has actually been detected, by chemical means, in the dust from the furniture of rooms hung with such paper. The possibilities of small quantities of arsenic entering the system accidentally must be apparent, when we observe the extended use made of the arsenical colors. The green paper meets us everywhere—on the walls, on paper boxes, labels, cards, tickets, stationery, paper lamp-shades, from which the arsenic is often volatilized by the heat of the lamp. I have perceived the characteristic odor of volatilized arsenic in lighting the gas with a wisp of arsenical letter paper. Such articles are constantly in the reach of children, and of adults ignorant as children of the dangerous character of the articles they are handling.

Who, knowing that a cake of emerald green—the favorite among all the colors—contains more than one-third of its weight of pure arsenic, would allow his children to use it unwarned? The use of green tartan in protecting chandeliers, picture-frames and mirror-frames, brings a dangerous article into the house. Not long since I saw, in a summer hotel, the dining table protected, in the interval between meals, by a voluminous net of green tartan, from which the arsenical powder was sifting upon the cloth and into the dishes at every touch. Has the time not come when this broadcast sowing of a dangerous and often unknown poison should be in some manner arrested?

Since I am considering arsenic in the arts as a cause of arsenical poisoning, I must not omit entirely the "Healing Art." You, gentlemen, use arsenic in a legitimate way. It has its place in the *Maeria Medica*. Yet the Toxicologist sometimes takes the liberty of overhauling the medicines dispensed according to the Doctor's prescription, just to be sure that all is right.

ARSENIC IN SUB-NITRATE OF BISMUTH.

Not long since I was called upon in connection with a case in which a man was on trial for murder by poisoning to give testimony as to what extent sub-nitrate of bismuth is contaminated with arsenic, it being well known that the ores of bismuth are rarely free from arsenic and also that the complete elimination of it is exceeding difficult.

Indeed, one of the highest authorities, if not the highest in Toxicology, in a work not yet translated into English, says: "The ores of bismuth being always arseniferous, it follows that arsenic only too frequently accompanies bismuth in its compounds, and it is even claimed that the efficiency of the preparations of bismuth in cases of diseases of the stomach, should be attributed to the arsenic which such preparations nearly always contain."

In the case to which I allude samples of sub-nitrate of bismuth were obtained from all the druggists of the village, five in number, and brought to me for analysis. They all contained arsenic. I then obtained a number of samples from different druggists in this city. These likewise all contained arsenic except a single specimen of Parisian manufacture which was entirely free.

In closing his address, Professor Lattimore presented a specimen of the metallic arsenic obtained from sub-nitrate of bismuth recently analyzed. Also, a number of specimens of paper of various kinds, all colored with arsenical pigments—wall paper, letter paper, envelopes, fancy paper, card board, tickets, etc., among the rest a "milk-ticket."

One of these sheets—a programme of the Rochester Free Academy for 1875—was accompanied by one-third of a grain of metallic arsenic extracted from a single programme.

He also presented specimens of green tartan with the arsenic in the form of sulphide extracted from a piece six inches square. It was equivalent to a little more than two grains of white arsenic. A yard therefore contains a quarter of an ounce of white arsenic and a ladies dress, if made in style, three ounces. In response to a request from the audience Dr. Lattimore explained several easy and rapid modes by which the presence of arsenic might be detected in arsenical paper.

